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as 149320000 kilometers, and the Moon's mean distance as 384000 kilometers.

Let S, M, E , be the centres of the Sun, Moon, and Earth respectively. Let $EM=1$, then $SE=388.854$, also $\angle MES=60^\circ$.

From Trigonometry we get

$$EM + ES : ES - EM = \tan \frac{1}{2}(EMS + ESM) : \tan \frac{1}{2}(EMS - ESM)$$

$$389.854 : 387.854 = \tan 60^\circ : \tan \frac{1}{2}(EMS - ESM).$$

$$\therefore \frac{1}{2}(EMS - ESM) = 59^\circ 52' 20'',$$

$$\therefore \angle EMS = 119^\circ 52' 20''.$$

Now since EM is perpendicular to the plane $N'BNP'$, and MS is perpendicular to the plane $N'GNP$, $\angle P'ME = 180^\circ - 119^\circ 52' 20'' = 60^\circ 7' 40'' = \theta$.

Let r =radius of the Moon, then MP the semi-conjugate diameter of the ellipse $N'GNP = r \cos \theta$.

Area of bright crescent $N'PNP'N' =$ area of semi-ellipse $NMNPN'$ subtracted from semi-circle $N'NPN'$; area semi-circle $= \frac{1}{2}\pi r^2$,

area semi ellipse $= \frac{1}{2}\pi r^2 \cos \theta$; and area crescent $= \frac{1}{2}\pi r^2 (1 - \cos \theta) = .250965 \pi r^2 = \frac{1}{4}$ of the disc nearly. In the above solution we have regarded the observer as being at the centre of the earth.

16. Yale Senior Prize Problem. Contributed by H. A. NEWTON, LL.D., Professor of Mathematics, Yale College, New Haven, Connecticut.

The axis of two right cylinders whose bases are circles of 4 and 6 inches radius respectively, intersect at right angles; compute to four decimal places the lengths of the curves of intersection of the two surfaces.

Solution by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Let $x^2 + y^2 = 36$, be the equation to the cylinder with base radius 6 inches.

$x^2 + z^2 = 16$, the equation to the cylinder with base radius 4 inches.

$$\text{Then } \frac{dy}{dx} = -\frac{x}{\sqrt{36-x^2}}, \quad \frac{dz}{dx} = -\frac{x}{\sqrt{16-x^2}}.$$

$$\therefore S = \int \left\{ 1 + \left(\frac{dy}{dx} \right)^2 + \left(\frac{dz}{dx} \right)^2 \right\}^{\frac{1}{2}} dx = \int \left\{ \frac{576-x^4}{(36-x^2)(16-x^2)} \right\}^{\frac{1}{2}} dx.$$

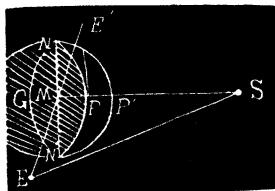
$$\text{The whole length of the curve} = 4s = 4 \int_0^4 \left\{ \frac{576-x^4}{(36-x^2)(16-x^2)} \right\}^{\frac{1}{2}} dx.$$

Let $x = 4 \sin \theta$.

$$\text{Then } 4s = 16 \int_0^{\frac{\pi}{2}} \left\{ \frac{9-4\sin^4 \theta}{9-4\sin^2 \theta} \right\}^{\frac{1}{2}} d\theta = 16 \int_0^{\frac{\pi}{2}} \left\{ \frac{1-e^2 \sin^4 \theta}{1-e^2 \sin^2 \theta} \right\}^{\frac{1}{2}} d\theta, \text{ where } e = \frac{2}{3}.$$

Expanding we get

$$4s = 16 \int_0^{\frac{\pi}{2}} (1 + \frac{2}{9} \sin^2 \theta - \frac{4}{9} \sin^4 \theta - \frac{1}{72} \sin^6 \theta - \frac{2}{864} \sin^8 \theta - \frac{4}{864} \sin^{10} \theta - \frac{1}{177144} \sin^{12} \theta - \frac{332}{177144} \sin^{14} \theta - \dots) d\theta.$$



$$4s = 8\pi(1 + \frac{1}{3} - \frac{1}{18} - \frac{1}{729} - \frac{1}{1048576} - \frac{875}{3888} - \frac{7}{478296} - \frac{847}{1190042784} - \dots).$$

$$4s = 26.0104 \text{ exact to two decimal places.}$$

Also solved by F. P. Matz, and J. F. W. Scheffer.

PROBLEMS.

30. Proposed by R. J. ADCOCK, Larchland, Illinois.

When the sum, of the distances of a point of a plane surface, from all its other points, is a minimum, that point is the centre of gravity of the plane surface.

QUERIES AND INFORMATION.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

"The Mysterious Formula."

Referring to my article on "Logarithms of Negative Numbers" published in the April Number, Vol. I., Mr. C. D. Schmitt, on page 214, deduces the following singular result: $\pi = \frac{\log(-1)}{\sqrt{-1}}$.

Another very remarkable result can be deduced from this as follows:

Dividing by 2, we have $\frac{1}{2\sqrt{-1}} \log(-1) = \frac{1}{2}\pi$. This may be written $\log \sqrt{-1} = \frac{1}{2}\pi$. $\therefore \sqrt{-1} = e^{\frac{1}{2}\pi} = 4.810477381$. This is what Professor Benjamin Peirce in his linear Associative Algebra, p. 5 (edition published by D. Van Nostrand), calls "the mysterious formula."

Writing i for $\sqrt{-1}$, the formula is $\frac{1}{i} = \sqrt{e^\pi}$.

M. C. STEVENS.

Editor Finkel has notified me that he cannot spare the space for further discussion of the possibility of a root of the equation

$4 + \sqrt{x-4} - \sqrt{x+4} = 0$. I will therefore again refer Mr. Draughton to Mr. Horner's article in the Philosophical Magazine, and also to Wentworth's Algebraic Analysis, page 278 to page 286.

H. C. WHITAKER.

The International Mathematical Congress.

Professor A. Vasiliev, President of the Physico-mathematical Society